AERMOD Modeling System Update: Plans/Priorities for Appendix W Updates

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AERMOD: Future Plans

- Overall, the AERMOD modeling system has been shown to perform well across a wide range of applications;
- However, with increased stringency of recent NAAQS the “margin for error” in compliance demonstrations has shrunk considerably;
- Conservatism of past practices (aka, the “Puzzle Book”), which have gone beyond Appendix W recommendations, has also contributed to the problem.

AERMOD: Future Plans (cont.)

- Within this context, several areas of potential concern have been identified, including:
  - Dispersion of low-level sources under low-wind/ stable conditions;
  - Building downwash, especially for complex structures and elongated buildings at angle to wind, and treatment of downwash under light wind/stable conditions;
  - NO_2/NO_x chemistry options for 1-hr NO_2 NAAQS;
  - Buoyant line sources (for which BLP Is the current preferred model); and
  - Non-population oriented “heat island” influences.

AERMOD: Future Plans (cont.)

- Progress has been made on some of these issues, e.g.,
  - Non-Default/Beta options in AERMET to adjust u* under low-wind/stable conditions;
  - Development of ARM2 method for NO_2 modeling;
  - Preliminary work on “effective” building length to use instead of projected length for elongated buildings, with support from ongoing EPA wind tunnel study;
  - Some work is underway to address non-population oriented “heat island” influences;
  - However, much work remains to be done to support revisions to regulatory options under Appendix W

AERMOD: Future Plans (cont.)

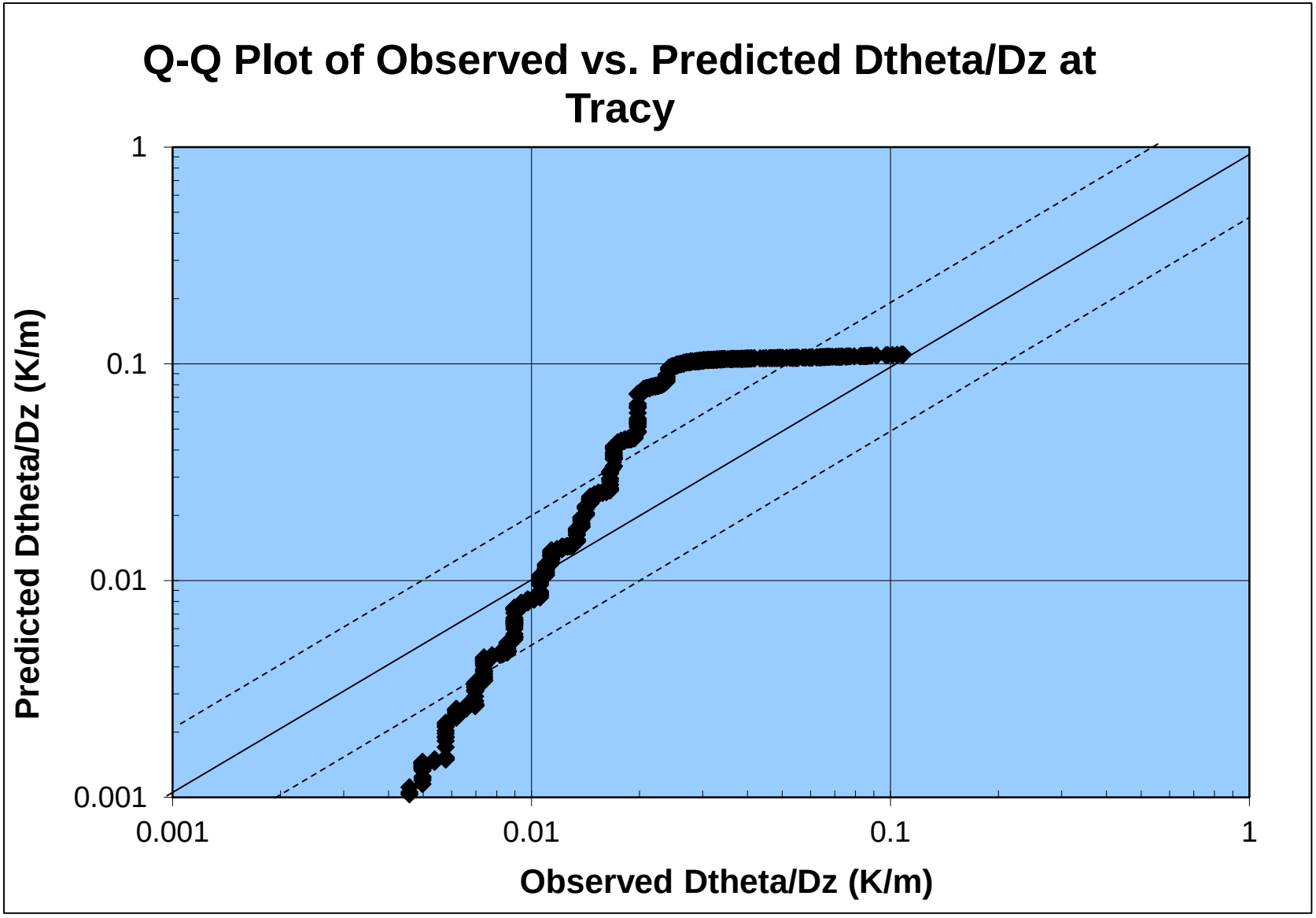
- Several potential issues had been identified by AERMIC prior to promulgation, but were not addressed in promulgated version, e.g.:
  - Transition from urban-enhanced dispersion under stable conditions to daytime convective conditions:
    - No “memory” of urban-enhanced dispersion once boundary layer turns convective could affect low-level sources;
    - Showed up as significant issue in application of AERMOD for Atlanta NO2 REA supporting the current 1-hr NAAQS;
    - Addressed for REA by adjusting mechanical mixing heights for first convective hour to be >/= urban mixing height;
    - More complete treatment implemented as “formulation bug fix” in v11059, with supporting performance evaluations.

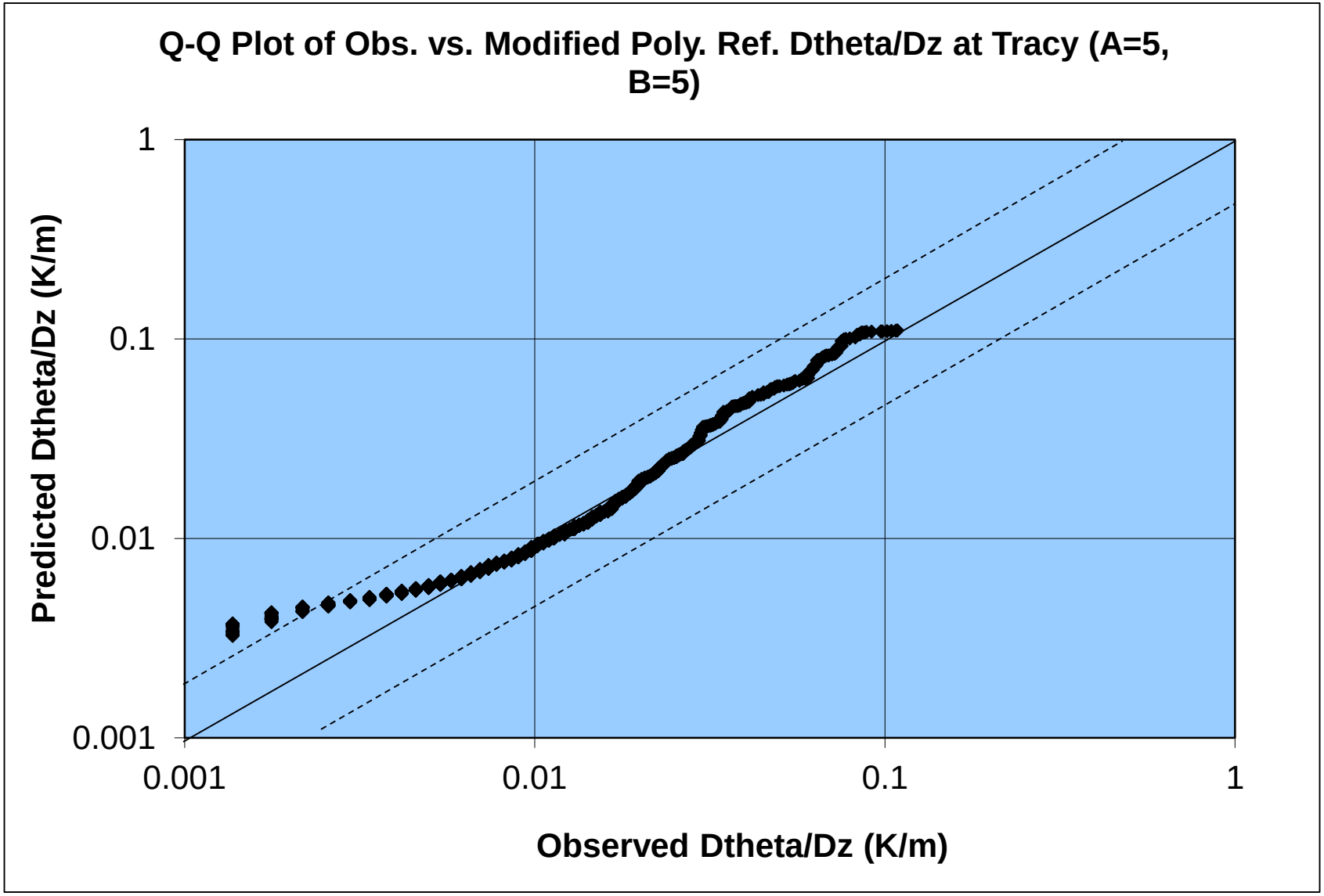
AERMOD: Future Plans (cont.)

- Other unresolved issues identified prior to promulgation include:
  - Treatment of buoyant plume rise for tall stacks in urban areas, where plume rise (not plume height) is limited based on 1.25 times the urban mixing height:
    - Could result in unrealistically high concentrations for some elevated sources, especially for relatively small urban populations;
    - Some preliminary work had been done based approach used for penetrated plumes in daytime convective conditions, but was not ready for promulgation;
    - Some guidance regarding this issue was incorporated in the AERMOD Implementation Guide.

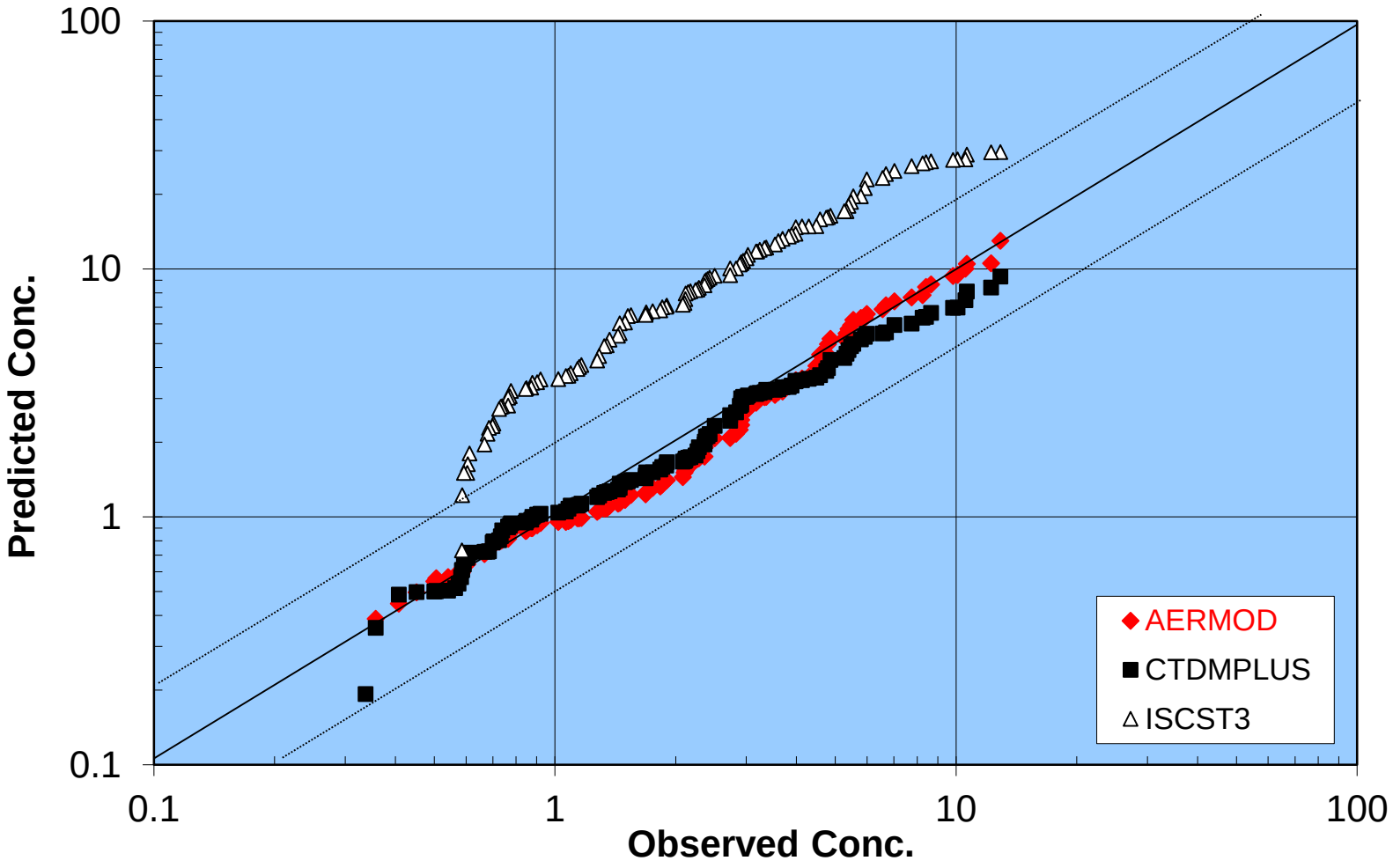
AERMOD: Future Plans (cont.)

- Treatment of inhomogeneous boundary layer (IBL) for the layer closest to the ground, which may be important for low-level releases under stable conditions; and the layers straddling the convective mixing height, which may be important for how much of plume penetrates top of mixed layer, and how much is re-entrained into the mixed layer.
- Default lapse rate (absent observed temperature profile) may introduce conservatism for some cases:
  - Some preliminary work on alternative approaches showed encouraging results for the Tracy database, which included observed temperature profile up to 400m:

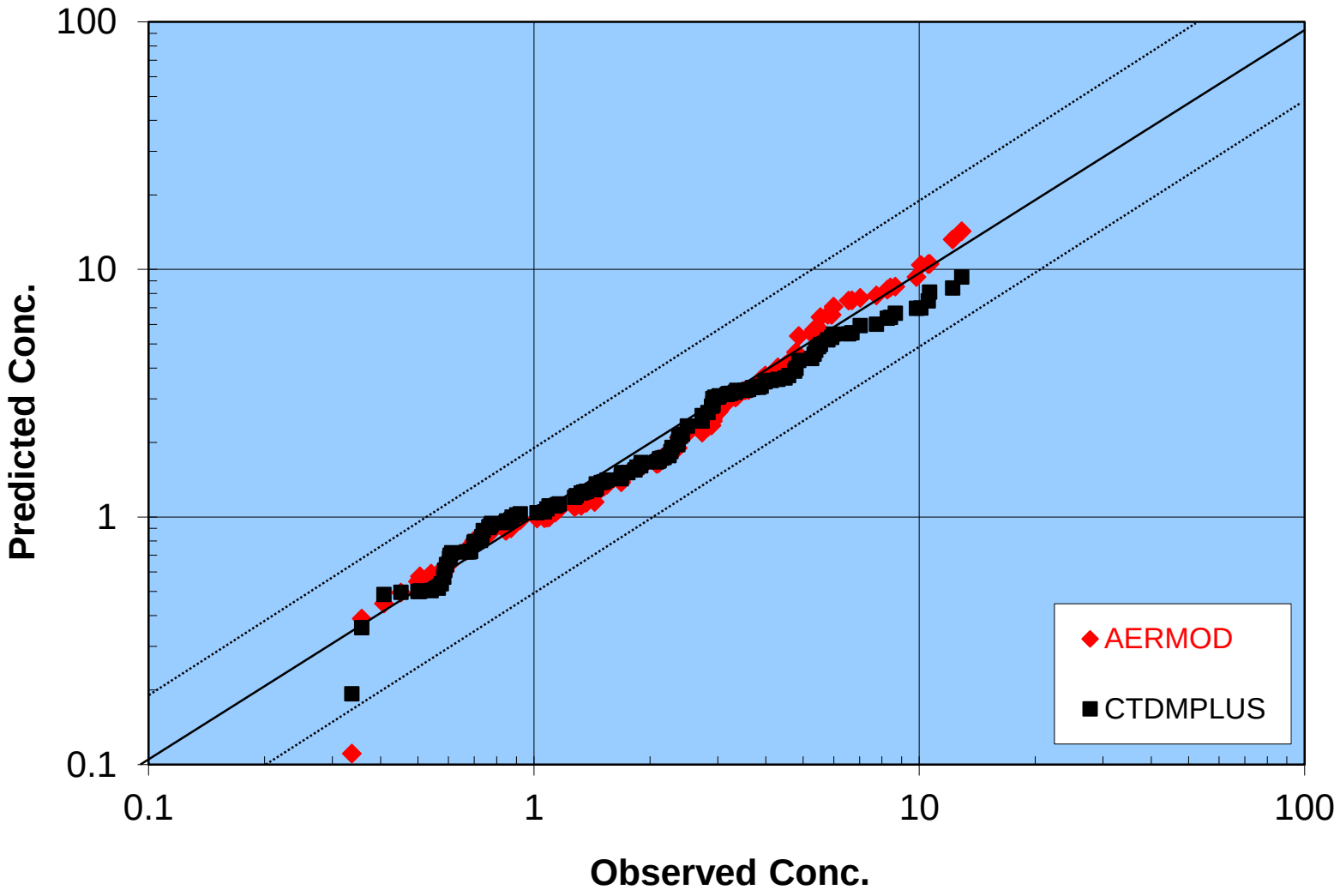

Q-Q Plot of Observed vs. Predicted Dtheta/Dz at Tracy
Predicted Dtheta/Dz (K/m)
Observed Dtheta/Dz (K/m)
1
0.1
0.01
0.001
0.001
0.01
0.1
1


Q-Q Plot of Obs. vs. Modified Poly. Ref. Dtheta/Dz at Tracy (A=5, B=5)
Predicted Dtheta/Dz (K/m)
1
0.1
0.01
0.001
0.001
0.01
0.1
1
Observed Dtheta/Dz (K/m)

Tracy SF_6 1-Hr Q-Q Plot (Conc.) - With Obs. DTDZ



Tracy SF_6 1-Hr Q-Q Plot - w/o Obs. DTDZ, Using Mod Prof



AERMOD: Future Plans

- Revisions to Appendix W will require concerted effort to identify, prioritize, and analyze the appropriate revisions;
- Identifying appropriate data and methods for evaluating formulation changes will be a significant challenge;

Future Plans for AERSURFACE

- Release Beta version of AERSURFACE with Effective Roughness Methods based on IBL approach:
  - Supports 1992, 2001 and 2006 NLCD data, supplemented by 2001/2006 Impervious and 2001 Canopy data;
  - Based on evaluation results, IBL approach shows better performance vs. IBL estimates than current approach with default 1km radius; however IBL/GFM results suggest that 1km is a reasonable default;
  - Beta version will utilize a pathway/keyword user interface, similar to AERMOD, and will include an option to specify different locations and separate data files for surface roughness vs. Bowen ratio and albedo, as discussed in Section 3.1.2 of AERMOD Implementation Guide;
  - Option to specify “airport” vs. “non-airport” by sector is also included for cases where buildings are located close to tower location.

Future Plans for AERSURFACE

- Release Gust Factor Tool for use with 1-min ASOS wind data:
  - Gust Factor Tool may provide a useful QA check for AERSURFACE results, potentially identifying issues with temporal representativeness of NLCD data, misclassified land cover categories, and/or errors in tower location;
  - Potential roll of Gust Factor Tool as source of surface roughness inputs to AERMET deserves further discussion, and it may be a viable alternative for estimating surface roughness in cases with significant NLCD issues.